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# Observations on the breeding of the American opossum in Florida

by

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## General Remarks

In view of the special status of the North American opossum (*Didelphis virginiana* Kerr) as the only marsupial species occurring north of Mexico, and its widespread distribution in the United States, it is surprising that the reproductive history of this interesting animal has not been more extensively studied. Only two important contributions deal with the reproduction of the opossum in a state of nature, and these are limited to southwestern areas. The pioneer studies of Hartman were carried out in Texas and appeared in a series of papers published from 1916 to 1928. They have recently been summarized in a fascinating historical account of the opossum (Hartman, 1952) in which a complete bibliography is found. The other study is more recent and deals with the opossum in California (Reynolds, 1952). This work is of special interest as the opossum is not native to the Pacific coastal region of the United States. Beginning about 1870 opossums were transported to California at various times by emigrants from central United States, and the animal is now widespread and well established as a breeding species (Grinnell, Dixon and Linsdale, 1937).

The work of Reynolds has further interest in that this author studied the reproduction of the opossum simultaneously in its natural state and under conditions of captivity. No important

differences were observed with respect to the main features of reproduction; wild and captive females enter into the first estrus and produce young at about the same time, and in general the length of the estrus cycle and the period required for rearing and weaning of young are the same. Reynolds gives no detailed description of the conditions under which captive animals were maintained; other workers, however, have found that the opossum does not do well in close confinement. Breeding is greatly reduced and irregular in occurrence, and the adults are hard to maintain in good physical condition. On the other hand, in large outdoor enclosures under more natural conditions breeding is improved (McCrady, 1938; Coghill, 1939; Moore and Bodian, 1940), although still far below the normal rate.

The embryological development of young opossums has been the subject of a series of papers by Hartman (1916, 1919, 1928) with main emphasis on the earlier stages, and McCrady (1938) has treated the entire intrauterine period of development in more detail, setting up a series of normal stages (1-35) recognizable on the basis of external form. According to McCrady birth takes place at stage 35, which is attained about 12 days 18 hours after mating. Reynolds thinks the average length of gestation is probably a little longer—13 days (±).

The gonads of newborn opossums are just at the threshold of histological differentiation, and many of the primordia representing the embryonic genital tract have not yet been laid down. For example, the ostium of the Müllerian duct is not formed until about the third day after birth and the duct is not complete until the tenth day. Prostatic buds do not appear in males until about the 17th day. The mesonephros remains functional during the first two weeks of postnatal life and retrogresses very slowly. Obviously the embryonic period as usually defined extends far beyond the stage of birth.

## Breeding Season in Various Regions of United States

The breeding season of the opossum varies considerably in different regions of the United States, being determined in a general way by latitude and climatic conditions. In the southern states it begins in mid-January and extends (including the period

of rearing young) until September or October. A relatively brief anestrum of 2-3 months follows. The opossum is polyestrus with cycles which average about 28 days according to HARTMAN (1923), or 29.5 days according to REYNOLDS (1952). The variation is very great, however, HARTMAN reporting a range of 24 to 34 days, REYNOLDS 22 to 38 days. Females which do not become pregnant run 5 or 6 cycles ordinarily before going into anestrum (REYNOLDS). Due to the long time required to rear the young after birth (3-4 months for a litter) only two litters can be reared in a year. However, if a litter is lost early, very often another is produced to take its place. Thus three litters (or in theory even more) might be born although not more than two can be reared to the weaning stage.

In southern latitudes first litters are born at the end of January and in February, and progressively later farther north. The second breeding takes place in May or June or even as late as July according to latitude. It appears that almost all females of breeding age and in good health breed at the first period; the production of second litters is, however, by no means so regular. Exact percentages cannot be given, but it is generally agreed that many females fail to breed a second time, and that the date of the second breeding when it occurs is more variable.

It is of interest also that a certain number of females breed while still very young, at a weight of hardly 40% of their final adult size. Female opossums that reach full size weigh up to 2.5 kgm. or sometimes even 3 kgm., but the average is much lower owing to the fact that many do not survive to reach full size. There are numerous records of very small females, weighing a kilogram, or even less, which had young or were pregnant. HARTMAN (1928) cites five such specimens (which he refers to as " adolescents "), weighing from 660-900 gms., and the writers have records of several young females weighing but little more than a kilogram which carried young (Table 3). It is thought (HARTMAN, REYNOLDS, e.g.) that such small females are from second litters of the preceding year and so would be about 6 months of age or somewhat more.

## The Breeding Season in Florida

In the course of an experimental study of gonad differentiation in opossum embryos it eventually became necessary to obtain the young at the earliest moment possible after birth. This could be

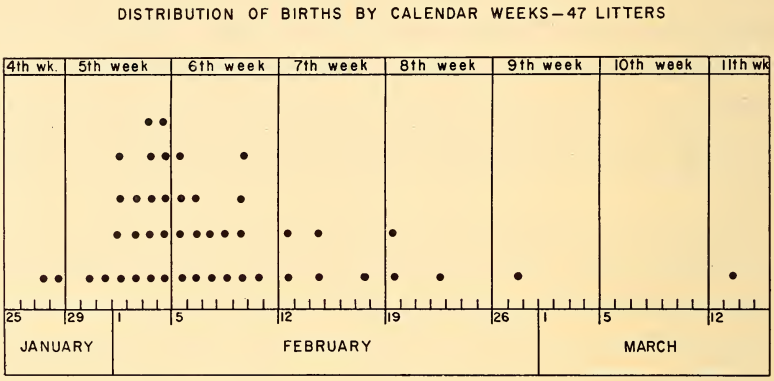


Table 1.
Birth dates of 47 litters of young opossums in northern Florida, 1953-1957.

best assured by trapping large numbers of wild females at the beginning of the breeding season (i.e. during the period between mating and birth of the young) in order to have the embryos born in the laboratory. Consequently a few years ago work was begun at the University of Florida where there was available an enclosed and protected forest area where opossums are numerous. In the course of this work much information was incidentally obtained on the reproductive activity of the opossum in Florida; and since almost nothing has been published on this subject from the eastern United States it seemed worthwhile to collect such data systematically for comparison with information available from other regions.

In Florida the first breeding season of the year begins very suddenly, females coming into estrus in mid-January. The first litters are born in the last few days of this month. A great majority of all litters (80% ±) are born between this time and February 10 —a remarkable concentration of births within a period of about

two weeks (Table 1). This indicates that a very high proportion of females breed and bear young following the first estrus period of the year; and there is reason to believe that the percentage of females breeding at this time may be even greater than appears in the table. It has been found that in many cases females which

Number of Young Opossums per Litter in Various Regions of the United States

| STATE | INVESTIGATOR | Average Number per Litter | Number of Litters |
|---|---|---|---|
| IOWA | Wiseman & Hendrickson–1950 | 9.0 | — |
| MISSOURI | Reynolds – 1945 | 8.9 | 42 |
| NEBRASKA | Reynolds (unpublished data–see Reynolds 1952) | 8.6 | 23 |
| MARYLAND | Llewellyn – unpublished data | 8.5 | 44 |
| KANSAS | Fitch & Sandidge – 1953 | 7.4 | 28 |
| CALIFORNIA | Reynolds – 1952 | 7.2 | 44 |
| TEXAS | Hartman – 1928 | 6.6 | 28 |
| TEXAS | Lay – 1942 | 6.8 | 65 |
| FLORIDA | Burns & Burns | 6.26 | 50 |

TABLE 2.

Average number of young per litter in various regions of the United States. In the case of Hartman, 1928, the data are taken from appendices A and B of that paper. They agree closely with the data of Lay.

happen to lose their young for any reason, at birth or afterwards, breed again rather promptly, and thus produce another litter after a certain delay. It is possible then that some of the scattered births occurring after February 10 (Table 1) are cases of this kind. This would increase the percentage of females which actually bred at the first estrus. On the other hand, some late births undoubtedly are due to failure to mate at the first period, or to the fact that a few females come into the first estrus rather late. This may sometimes be the case for the young females mentioned earlier (p. 597), but it is certainly not the rule, since some small females are found among the earliest breeders.

It is seen from the data of Table 1 that there is a remarkable concentration of births in early February. This climactic period of reproduction falls about a week later than the corresponding peak in Texas, according to HARTMAN (1928), and a week earlier than the peak recorded for California by REYNOLDS. (See BURNS and BURNS, 1956, Table 2. In the case of REYNOLDS' data the birth date is obtained by adding 13 days, the length of gestation, to the date of the first estrus.) In Texas and California also the period of births is not so sharply concentrated as in Florida and at present the reason for this difference is not apparent.

## AVERAGE NUMBER OF YOUNG PER LITTER IN VARIOUS REGIONS

It is interesting to compare the average number of young per litter in Florida with other areas of the United States for which adequate data are available. These regions all lie west of the Mississippi River, representing the west central and southwestern

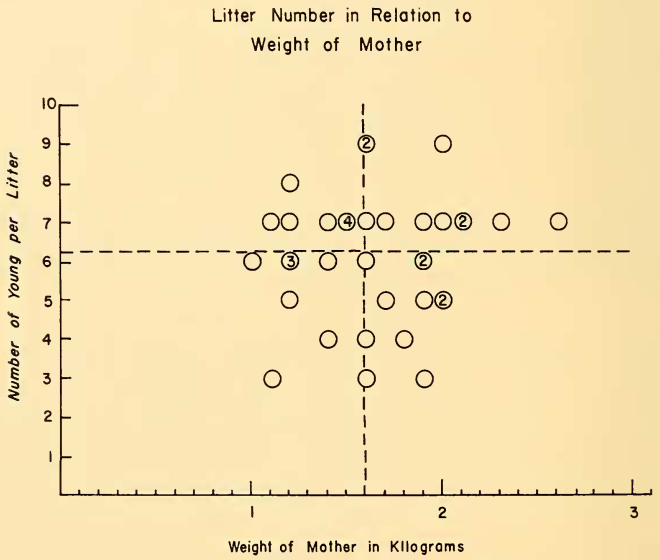


TABLE 3.

Number of young per litter for 38 litters of young opossums in relation to the weight of the mother. There is no correlation between the weight of the mother and the number of young in the pouch. Numbers in circles indicate number of litters in that position.

regions of the country (Table 2). In general, litter size decreases steadily with latitude from north to south, and the average number per litter for Florida (6.25) is the lowest yet recorded. Data are lacking to determine whether this decline is correlated with the size of the adult animal. In Florida adult opossums tend to be somewhat smaller than in northern United States; however, in Florida there is no correlation whatever between the size of the mother and the average number of young. Females of less than average size, even those very small females referred to earlier which breed at an age of 6 or 7 months, may have litters as large as those of fully grown females (Table 3).

Litter size as listed in Table 2 does not refer to the number of young actually born; it means the number found attached and undergoing development in the pouch. In the case of the Florida data the litters were of various ages, from a few days after birth to large young almost ready to leave the pouch. The number born is much larger, but many do not succeed in entering the pouch and some that get in fail to find a nipple—a question to be considered later.

## Length of Gestation and Stage at Which the Young are Born

There is now rather close agreement on the length of gestation in the opossum. McCrady (1938) placed the duration at 12 days 18+ hours and evidently believed that birth occurs rather precisely at this time. Reynolds (1952) considers it to be about 13 days and recognizes variation over a range of as much as 12 hours (p. 239). He believes the differences are probably due to variation in the time of ovulation. Since the cases in which both mating and birth of the young have been observed are few, and since ovulation is spontaneous in the opossum and not determined by copulation, it is impossible to be precise on this point.

On the other hand, there is direct evidence of another kind indicating considerable variation in the time of birth. This evidence is based on marked morphological differences in different litters at birth. McCrady (1938) described a series of normal stages for the period of intrauterine development which are readily distinguishable in the later stages of gestation by differences in

external form. After the tenth day the stages are separated by half-day intervals. Birth occurs at stage 35, which falls about the middle of the second half of the 13th day (12 days, 18+ hours, as noted above). The stages are thus of 12 hours duration, and of course the transitions are gradual. Stage 34 is centered, then, around the middle of the first half of the 13th day, about 12 hours earlier than stage 35. It is characterized by two external features. The general form of the head is elongate and angular, giving it a curious block-like appearance, whereas at stage 35 the head is rounded or ovoid in shape. But even more diagnostic is the unique oral shield (McCrady, 1938, fig. 53) which is fully developed at stage 34 but has disappeared at stage 35. On close inspection it is easy to distinguish the two stages on the basis of these characters (see figs. 2 and 3, Burns, 1956).

During recent years a considerable number of litters have been obtained which were born at stage 34; moreover, Hartman (1952) shows photographs of three different litters (pp. 90, 96, 113), labeled " new-born ", which from the configuration of the heads are certainly at stage 34. It would appear, then, that birth not infrequently takes place at this stage, some 12 hours earlier than the time assigned by McCrady. Nor can these litters be considered " premature " in the usual sense. They suffer no apparent handicaps and are fully viable, as evidenced by the fact that they are found in the pouch and attached to the nipples in the same numbers (on the average) as those born later. Also they survive experimental treatment just as well. This discovery has been of great importance in the experimental work. At stage 34 the embryonic testis responds readily to hormone treatment. Estradiol dipropionate transforms it readily into a somewhat imperfect ovary. By stage 35 such reactivity has been lost entirely (Burns, 1955, 1956).

## Reproductive Capacity of the Opossum and its Limiting Factors

The reproductive capacity of the opossum cannot be gauged or understood on any single basis. Primarily, fertility depends on the number of eggs which may be matured and ovulated, and this number is very large indeed. According to Hartman (1952)

30 eggs or more are not infrequently produced. He has records as follows: 30, 33, 33, 36, 39, 39, 43, 44, 44, 45, 56; and these numbers are of eggs actually recovered after washing out the uteri. Many, however, had not been fertilized or at least were not developing, and a considerable loss evidently occurs early in development.

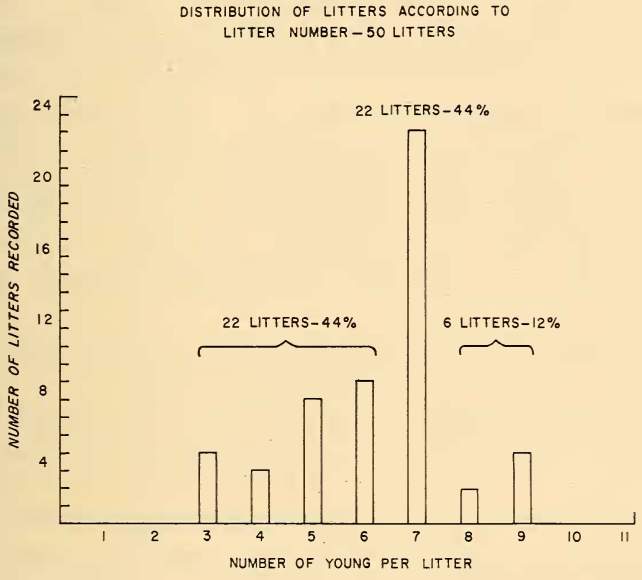


TABLE 4.

Number of young for 50 litters of young opossums arranged according to litter size. The great majority of litters consisted of seven young or less.

Later in gestation HARTMAN reports an average of 22 blastocysts in the uteri where they are often very crowded. This condition probably results in further losses prior to birth.

The question arises next as to the number born, and the losses that ensue through failure to get into the pouch and to find a nipple. Since birth is rarely observed in the opossum, existing data are hardly adequate to settle these points with finality, but they are highly interesting and suggestive. In many cases the numbers born are certainly large, and may approach the average number of blastocysts (22) cited by HARTMAN in his studies of development *in utero*. REYNOLDS (1952, pp. 256-258) actually

observed the birth of four litters of 4, 15, 13 and 25 young—a total of 57. Of these only 34 (or 60%) succeeded in gaining the pouch, and some of these failed to find a nipple. On the other hand HARTMAN (1952) cites an instance in which 21 newborn young were seen in the pouch of which 12 were attached—certainly an exceptional case.

There is, then, inevitably a great loss of young at birth due to failure to get into the pouch or failure to find a nipple. As there are only 13 nipples (or very exceptionally an extra pair) this is obviously a final limiting factor, and, as REYNOLDS suggests, perhaps not all nipples are functional. Reference to Table 2 shows that average litter numbers fall far short of the number of nipples except in the more northern states. In any region litters of more than 10 are certainly uncommon. The reason is not clear unless it is a question of the number of nipples that are functional.

REYNOLDS mentions further that in California 25% of all litters consisted of 7 young, and notes a tendency for the young to occupy the more posterior nipples. In some cases the anterior nipples appeared to be less developed, but histological studies were not made. It is a curious fact that in Florida no less than 44% of all the litters recorded had 7 young (Table 4) suggesting that this is the " optimal " number. However, the remaining litters are not evenly distributed around 7 as a mean; almost all have less than 7 and only 6 litters out of a total of fifty have more than that number. It would appear that some condition is tending to restrict litter numbers to 7 or less and, as suggested above, it is possibly a matter of the number of nipples which are functional. As yet there has been no opportunity to investigate this interesting question.

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